

## WELDING AND CUTTING

### 10.A GENERAL

10.A.01 Welders, cutters, and their supervisor shall be trained in the safe operation of their equipment, safe welding/cutting practices, and welding/cutting respiratory and fire protection.

**> American Industrial Hygiene Association publication "Welding Health and Safety" is recommended**

10.A.02 All welding equipment shall be inspected daily: defective equipment shall be removed from service, replaced or repaired, and reinspected before again being placed in service.

10.A.03 Electrical and pressurized system requirements.

- a. Welding cylinders and their use shall meet the applicable requirements of Section 20, Pressurized Systems.
- b. Arc welding and cutting systems and their use shall meet the applicable requirements of Section 11, Electrical.

10.A.04 Workers and the public shall be shielded from welding rays, flashes, sparks, molten metal, and slag.

10.A.05 Cable, hoses, and other equipment shall be kept clear of passageways, ladders, and stairways.

10.A.06 Welding and cutting of hazardous materials.

- a. When welding, cutting, or heating on steel pipelines containing natural gas, 49 CFR Part 192, Welding of Steel in Pipelines, shall apply.
- b. Before welding, cutting, or heating is commenced on any surface covered by a preservative coating whose flammability is not known, a test shall be made to determine its flammability: preservative coatings shall be considered highly flammable when scrapings burn with extreme rapidity.
- c. Preservative coatings shall be removed a sufficient distance from the area to be heated to ensure any temperature increase of the unstripped metal will not be appreciable: artificial cooling of the metal surrounding the heating area may be used to limit the area to be stripped.
- d. When welding, cutting, or heating toxic preservative coatings in enclosed spaces, all surfaces covered with toxic preservatives shall be stripped of such coverings for a distance of at least 10 cm (4 in) from the area of heat application or the employees shall be protected by air line respirators.
- e. When welding, cutting, or heating toxic preservative coatings in the open air, employees shall be protected by respirator.

10.A.07 All structural welding accomplished by the contractor or subcontractor on critical items such as scaffolding, shoring, forms, ladders, piling, etc., shall be performed by certified welders using qualified welding procedures.

10.A.08 Before heat is applied to a drum, container, or hollow structure, a vent or opening shall be provided for the release of any built-up pressure generated during the application of heat.

10.A.09 Employees performing welding, cutting, or heating shall be protected by PPE appropriate for the hazards: respiratory, vision, and skin protection required in this section shall be in compliance with applicable requirements of Section 5.

10.A.10 All welding and cutting equipment and operations shall be in accordance with standards and recommended practices of American National Standards Institute standard ANSI Z49.1.

## **10.B RESPIRATORY PROTECTION**

10.B.01 All welding, cutting, and heating operations shall be ventilated (natural or mechanical) such that personnel exposures to hazardous concentrations of airborne contaminants are within acceptable limits. > **See Section 6**

10.B.02 Welding, cutting, and heating not involving conditions or materials described in this section may normally be done without mechanical ventilation or respiratory protective equipment.

10.B.03 Either general mechanical or local exhaust ventilation shall be provided whenever welding, cutting, or heating is performed in a confined space. > **See paragraphs 10.A.06.d and 10.B.04.b**

10.B.04 Materials of toxic significance. Welding, cutting, or heating operations which involve or generate any of the substances listed below shall be performed in accordance with the following subparagraphs. > **See also paragraphs 10.A.06.d**

Antimony   Arsenic   Barium   Beryllium   Cadmium  
Chromium   Cobalt   Copper   Lead   Manganese  
Mercury   Nickel   Ozone   Selenium   Silver   Vanadium

- a. Whenever these materials are encountered in confined spaces, local mechanical exhaust ventilation and personal respiratory protection shall be used.
- b. Whenever these materials, except beryllium, are encountered in indoor operations, local mechanical exhaust ventilation shall be used: when beryllium is encountered in indoor operations, local mechanical exhaust ventilation and personal respiratory protection shall be used.
- c. Whenever these materials are encountered in outdoor operations, personal respiratory protection shall be used.

10.B.05 Welding, cutting, or heating operations which involve or generate fluorine or zinc compounds shall be performed in accordance with the following.

- a. In confined spaces, local mechanical exhaust ventilation or personal respiratory protection shall be used.
- b. In open spaces, sampling shall be performed to determine concentrations of fluorides or zinc compounds and the need for local exhaust ventilation or personal respiratory protection.

10.B.06 Arc and gas cutting. Oxygen cutting using either an iron powder or chemical flux, gas-shielded arc cutting, and plasma cutting shall employ local mechanical exhaust ventilation or other means adequate to remove the fumes generated.

10.B.07 Other persons exposed to the same atmosphere as welders or cutters shall be protected in the same manner as welders or cutters.

## **10.C FIRE PROTECTION**

10.C.01 Compatible fire extinguishing equipment shall be provided in the immediate vicinity of welding or cutting operations.

10.C.02 Before conducting welding or cutting operations, the area shall be surveyed to ensure it is free of the following hazards:

- a. proximate combustible materials,
- b. the presence or possible generation of potentially explosive atmospheres (flammable gases, vapors, liquids, or dusts), and
- c. the presence or nature of an oxygen-enriched atmosphere.

10.C.03 Hierarchy of fire control. Objects to be welded, cut, or heated shall be:

- a. moved to a location free of dangerous combustibles;
- b. if the work cannot be moved, all moveable fire hazards in the vicinity shall be taken to a safe place (moved at least 11 m (35 ft) horizontally from the welding or cutting area) or the combustible material and construction shall be protected from the heat, sparks, and slag of welding;
- c. when welding or cutting must be done in a location where combustible or flammable materials are located, inspection and written authorization by the designated authority shall be required before such operations are begun (the location shall be checked for latent fires after the work is completed).

10.C.04 When a welding, cutting, or heating operation is such that normal fire prevention precautions are not sufficient, additional personnel shall be assigned to guard against fire and instructed in anticipated fire hazards and how fire fighting equipment is to be used.

10.C.05 When welding or cutting is to be done over combustible flooring, the flooring shall be protected by fire-resistant shielding, covered with damp sand, or kept wet: where flooring is wet or damp, personnel operating arc welding or cutting equipment shall be protected from possible shock.

10.C.06 Noncombustible barriers shall be installed below welding or burning operations in a shaft or raise.

10.C.07 Openings or cracks in walls, floors, or ducts within 11 m (35 ft) of the site shall be tightly covered to prevent the passage of sparks to adjacent areas.

10.C.08 Where welding or cutting is to be done near walls, partitions, ceiling or roof of combustible construction, fire resistant guards shall be provided to prevent ignition.

10.C.09 Where welding or cutting is to be done on a metal wall, partition, ceiling, or roof, precautions shall be taken to prevent ignition, due to heat conduction or radiation, of combustibles on the other side.

10.C.10 Welding or cutting shall not be done on a metal partition, wall, ceiling, or roof with a combustible covering nor on walls or partitions of combustible sandwich-type panel construction.

10.C.11 before welding or cutting drums, tanks, or other containers and equipment which have contained hazardous materials the containers shall be thoroughly cleaned in accordance with NFPA 327, *Cleaning or Safeguarding Small Tanks and Containers*, and ANSI/AWS F4.1, *Recommended Safe Practices for the Preparation for Welding and Cutting of Containers that have Held Hazardous Substances*.

10.C.12 Hot tapping or other welding or cutting on a flammable gas or liquid transmission or distribution pipeline shall be performed only by personnel qualified to make hot taps and only with the permission of the designated authorities.

10.C.13 When welding or cutting is done near a sprinkler head, a wet cloth shall be used to cover the head during, and then removed at the completion of, the welding or cutting.

10.C.14 When welding or cutting in areas protected by fire detection and suppression systems, precautions shall be taken to avoid accidental initiation of these systems.

## **10.D OXYFUEL GAS WELDING AND CUTTING**

10.D.01 Oxyfuel gas welding and cutting equipment shall be listed by a nationally recognized testing laboratory.

10.D.02 Oxygen cylinders and apparatus.

- a. Oxygen cylinders and apparatus shall be kept free from oil, grease, and other flammable or explosive substances and shall not be handled with oily hands or gloves.
- b. Oxygen cylinders and apparatus shall not be used interchangeably with any other gas.

10.D.03 Hose.

- a. Fuel gas hose and oxygen hose shall be readily distinguishable from each other.
- b. Oxygen and fuel gas hoses shall not be interchangeable; a single hose having more than one gas passage shall not be used.
- c. Hose couplings of the type that can be unlocked or disconnected without a rotary motion are prohibited.
- d. Hose which has been subject to flashback or which shows severe wear or damage shall be tested to twice the normal pressure to which it is subjected, and in no case less than 2100 kPa (300 psi); defective hose, or hose in doubtful condition, shall not be used.
- e. When parallel runs of oxygen and fuel gas hose are taped together, not more than 10 out of every 30 cm (4 out of every 12 in) shall be covered by tape.
- f. Boxes used for the storage of gas hose shall be ventilated.
- g. Hose connections shall be clamped or otherwise securely fastened in a manner that will withstand, without leakage, twice the pressure to which they are normally subjected in service, but not less than 2100 kPa (300 psi).

#### 10.D.04 Torches.

- a. Torches shall be inspected, at the beginning of each working shift, for leaking shutoff valves, hose couplings, and tip connections: defective torches shall not be used.
- b. Hoses shall be purged individually before lighting the torch for the first time each day: hoses shall not be purged into confined spaces or near ignition sources.
- c. Clogged torch tip openings shall be cleaned with suitable cleaning wires, drills, or other devices designed for such purposes.
- d. Torches shall be lighted by friction lighters or other approved devices, not by matches or from hot work.

10.D.05 Torch valves shall be closed and the gas supply shut off whenever work is suspended.

10.D.06 The torch and hose shall be removed from confined spaces whenever work is suspended.

#### 10.D.07 Protective equipment.

- a. Oxyfuel gas, and other fuel gas-oxygen, welding and cutting systems utilizing cylinder-hose-torch shall have a reverse-flow check valve, in each hose, between the torch and the regulator. (Reverse-flow check valves that are integral with the torch are acceptable.)
- b. When fuel gas-oxygen systems are manifolded together the provisions of NFPA

51 shall apply.

10.D.08 Connection of multiple sets of oxyacetylene hoses to a single regulator on a single set of oxyacetylene tanks may only be accomplished by installing a commercially available fitting approved by Compressed Gas Association (CGA) standards and listed by a nationally recognized testing laboratory. The fitting shall be installed on the output side of the regulator and shall have a built-in shut-off valve and reverse-flow check valve on each branch.

10.D.09 Acetylene regulators shall not be adjusted to permit a discharge greater than 100 kPa (15 psig).

## **10.E ARC WELDING AND CUTTING**

10.E.01 Electric welding apparatus shall be installed, maintained, and operated in accordance with the NEC.

10.E.02 Manual electrode holders.

- a. Only manual electrode holders specifically designed for arc welding and cutting of a capacity capable of safely handling the maximum rated current required by the electrodes may be used.
- b. All current carrying parts of the holder which are gripped by the welder or cutter, and the outer jaws of the holder, shall be fully insulated against the maximum voltage encountered to ground.

10.E.03 Cables and connectors.

- a. Cables shall be completely insulated, flexible, capable of handling the maximum current requirements of the work in progress, and in good repair.
- b. Cables with splices or repaired insulation within 10 feet of the holder shall not be used.
- c. Where it becomes necessary to connect or splice lengths of cable together, insulated connectors of a capacity at least equivalent to that of the cable shall be used. When connections are affected by cable lugs, they shall be securely fastened together to give good electrical contact and the exposed metal parts of the lugs shall be completely insulated.

10.E.04 The frames of arc welding and cutting machines shall be grounded either by a third wire in the cable connecting the circuit conductor or by a separate wire which is grounded at the source of the current.

10.E.05 Neither terminal of the welding generator shall be bonded to the frame of the welder.

10.E.06 Pipe lines containing gases or flammable liquids or conduits carrying electrical conductors shall not be used for a ground return circuit.

10.E.07 Circuits from welding machines used for other than welding tools shall be grounded.

10.E.08 Welding supply cables shall not be placed near power supply cables or other high-tension wires.

10.E.09 Welding leads shall not be permitted to contact metal parts support suspended scaffolds.

10.E.10 Switching equipment for shutting down the welding machine shall be provided on or near the welding machine.

10.E.11 Equipment shall be shut down when the leads are unattended.

10.E.12 Arc welding and cutting operations shall be shielded by noncombustible or flameproof screens to protect employees and other visitors from the direct rays of the arc.

10.E.13 Coiled welding cable shall be spread out before use.

## **10.F GAS METAL ARC WELDING**

10.F.01 Chlorinated solvents shall be kept at least 61 m (200 ft), unless shielded, from the exposed arc. Surfaces prepared with chlorinated solvents shall be dry before welding is permitted on such surfaces.

10.F.02 Persons in the area not protected from the arc by screening shall be protected by filter lenses. When two or more welders are exposed to each other's arc, filter lens goggles shall be worn under welding helmets: hand shields shall be used to protect the welders against flashes and radiant energy when either the helmet is lifted or the shield is removed.

10.F.03 Welders and other persons who are exposed to radiation shall be protected so that the skin is covered to prevent burns and other damage by ultraviolet rays. Welding helmets and hand shields shall be free of leaks, openings, and highly reflective surfaces.

10.F.04 When gas metal arc welding is performed on stainless steel, persons will be protected against dangerous concentrations of nitrogen dioxide by local exhaust ventilation or air line respirators.

## **DEFINITIONS**

Arc: a controlled electrical discharge between the electrode and the workpiece that is formed and sustained by a gas that has been heated to such a temperature that it can conduct electric current.

Arc cutting: a thermal cutting process that severs or removes metal by melting with the

heat of an arc between an electrode and the workpiece.

Arc welding: a welding process that joins workpieces by heating them with an arc.

Brazing: a welding process that joins materials by heating them to a temperature which will not melt them but will melt a filler material which adheres to them and forms a joint.

Cylinder manifold: a multiple header for interconnection of gas sources with distribution points.

Electrode: a flux coated wire rod.

Flashback: a recession of the flame into or back of the mixing chamber of the oxyfuel gas torch.

Fuel gas: a gas (e.g., acetylene, hydrogen, natural gas, propane) used with oxygen in the oxyfuel process and for heating.

Gas metal arc welding (GMAW): an arc welding process that uses an arc between a continuous filler metal electrode and the weld pool; shielding (from the atmosphere) is provided by an externally supplied gas.

Heating torch: a device for directing the heating flame produced by the controlled combustion of fuel gases.

Hot tapping: a procedure of attaching connections to equipment in service by welding and drilling.

Oxyfuel gas cutting: an oxygen cutting process that uses heat from an oxyfuel gas flame.

Oxyfuel gas welding: a welding process that joins workpieces by heating them with an oxyfuel gas flame.

Soldering: a welding process that joins materials by heating them to a temperature which will not melt them but will melt a filler material which adheres to them and forms a joint.